MATTOLE RIVER

APPENDIX D: HYDROLOGY

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I. GENERAL BASIN DESCRIPTION

The Mattole River is located in the northwestern California about 40 miles south of Eureka in Humboldt County. The Bear River borders the Mattole River on the North and to the east by the South Fork Eel River. There are a series of ridges within the basin including the King Range to the west. The Mattole River drainage basin is about 304 square miles. The basin varies in width from 4 to 12 miles and is about 36 miles long. Topographic elevations vary from sea level to 4,087 feet at Kings Peak. The stream channel of the Mattole River is about 62 miles long and rises gradually from sea level to 50 feet at Petrolia, approximately 1,000 feet near Whitethorn and to about 1,350 feet at Four Corners near the headwaters in Mendocino County.

Starting as a small stream flowing almost due east through mild gradients, the river turns north and then west and is joined by approximately 74 tributaries. The river flows into an abbreviated estuary at the mouth before entering the Pacific Ocean. The Mattole River flows all year but with tremendous differences between the summer and winter.

The climate within the basin is relatively moderate with a large portion being influenced by the Pacific Ocean. Temperatures along the coast regions only vary by 10 to 15 degrees with the inland portions of the basin ranging from the 30's to the upper 90's.

DWR's Statewide Planning Program delineates the Mattole watershed within the North Coast Hydrologic Region (HR), the Coastal (#03) Planning Subarea (PSA), and the Mattole-Bear (#27) Detailed Analysis Unit (DAU). The USGS delineates the Mattole watershed within Hydrologic Unit #18010107.

The Mattole River assessment team has divided the watershed into five principal watersheds for assessment purposes. These divisions are considered "sub planning watersheds" under the CalWater 2.2 Planning Watershed designation: Northern (33% of drainage), Western (30%), Eastern (27%), Southern (9%), and Estuary (1%).

Only one stream gauge, "Mattole River near Petrolia", USGS gauge #11469000, operated for a significant period (December 1950 – present). The gauge is located near the town of Petrolia and measures the run-off from 245 or 81% of the total 304 square mile Mattole River watershed.

II. PRECIPITATION

The climate within the Mattole basin is characterized by moderate temperatures in the summer and profuse rainfall patterns during the winter. Winter storms move inland in a northeasterly direction from the Pacific Ocean. Storms must first pass over the 1,000 to 2000 foot Cooskie Ridge before reaching Honeydew and another 1,000 to 1,500 foot increase in elevation to cross the Bull Creek divide through Panther Gap to pass into the South Fork Eel River drainage. It is this orographic uplift in such a short distance from the coastline that results in heavy rainfall in the Honeydew area.

There are twelve precipitation gauges located within the Mattole River watershed. Five of these gauges were in operation longer then twenty years with a cumulative operating time from 1898 to 2000. There are another eight gauges located within ten miles of the watershed boundary. Table II-1 contains the gauge identifiers, location, period of record, annual, and maximum daily precipitation for the long-term gauges within or near the Mattole River watershed. Chart II-1 graphically illustrates the period of record for the gauges. Figure II-1 provides a location map. The mean annual precipitation for the gauges located within the Mattole basin is 84.56 inches. The maximum precipitation within the basin was 217.74 inches at the Honeydew Store gauge in 1983 and the minimum precipitation was 25.43 at the Upper Mattole gauge in 1977. The large variance in precipitation is attributed to the swift increase in elevation in such a short distance from the coastline.

Two of the longest operating precipitation gauges within the Mattole River watershed are the Petrolia gauge at Petrolia at an elevation of 175 feet and the Upper Mattole gauge located at an elevation of 255 feet. Chart II-2 shows the annual precipitation at the Petrolia gauge along with the cumulative departure from the mean and a 5-year running average for water years 1959 -1995. The mean for the 37-year record is 62.43 inches. The wettest year was 1983 with 109.76 inches of rainfall. The driest year was 1977 with 27.24 inches of rainfall. Chart II-3 shows the annual precipitation at the Upper Mattole rain gauge along with the cumulative departure from the mean for water years 1898 - 1986. The mean for the 98-year record is 78.70 inches. The wettest year was 1904 when 130.64 inches fell. The driest year was 1977 when 25.43 inches fell.

Table II-1: Existing and discontinued long-term precipitation gauges within and near the Mattole watershed.

EXISTING AND DISCONTINUED LONG-TERM PRECIPITATION GAUGES LOCATED WITHIN OR NEAR THE MATTOLE RIVER WATERSHED								
Station Name	**Upper Mattole 1/**	**Petrolia 1/**	**Whitethorn 1/**	**Honeydew 2WSW 1/**	**Honeydew Store 1/**	**Scotia**	**Burlington State Park**	**Cape Mendocino Light House**
Station #	**F70 9177 00**	**F70 6835 01**	**F70 9654 00**	**F60 4074 00**	**F70 4074 10**	**F60 8045 00**	**F60 1202 00**	**F70 1504 00**
GAUGE LOCATION								
County	Humboldt	Humboldt	Humboldt	Humboldt	Humboldt	Humboldt	Humboldt	Humboldt
Longitude	124.183	124.280	123.937	124.150	124.122	124.100	123.907	124.405
Latitude	40.250	40.234	40.022	40.238	40.244	40.483	40.308	40.440
Elevation	255	175	1050	380	339	140	200	425
PERIOD OF RECORD								
Begin	1898	1958	1965	1954	1975	1927	1950	1895
End	1986	1995	1990	1978 2/	1994 3/	present	1998	1943 4/
ANNUAL PRECIPITATION								
Average	78.70	62.43	84.35	101.65	77.33	48.19	65.73	40.11
Maximum	130.64	109.76	144.05	174.40	159.21	84.45	118.57	64.10
Year	1904	1983	1983	1958	1983	1983	1983	1907
Minimum	25.43	27.24	35.37	31.05	33.05	19.71	27.29	14.78
Year	1977	1977	1977	1977	1977	1977	1977	1931
24-HOUR MAXIMUM PRECIPITATION								
Average	5.13	3.94	5.42	7.71	6.88	3.22	4.39	1.94
Maximum	9.35	6.42	9.61	13.65	11.40	5.95	7.40	3.30
Year	1940	1995	1966	1956	1985	1940	1974	1927
Minimum	1.40	1.97	2.09	5.00	2.60	1.17	1.78	1.00
Year	1977	1977	1977	1978	1992	1977	1977	1930
Notes: 1/	Gauge located within the Mattole watershed.							
2/	Inactive 1972 - 1974.							
3/	Inactive 1986 - 1989.							
4/	Inactive 1910 - 1912, 1914 & 1919 - 1924.							

Chart II-1: Period of record for precipitation gauges within and near the Mattole watershed.

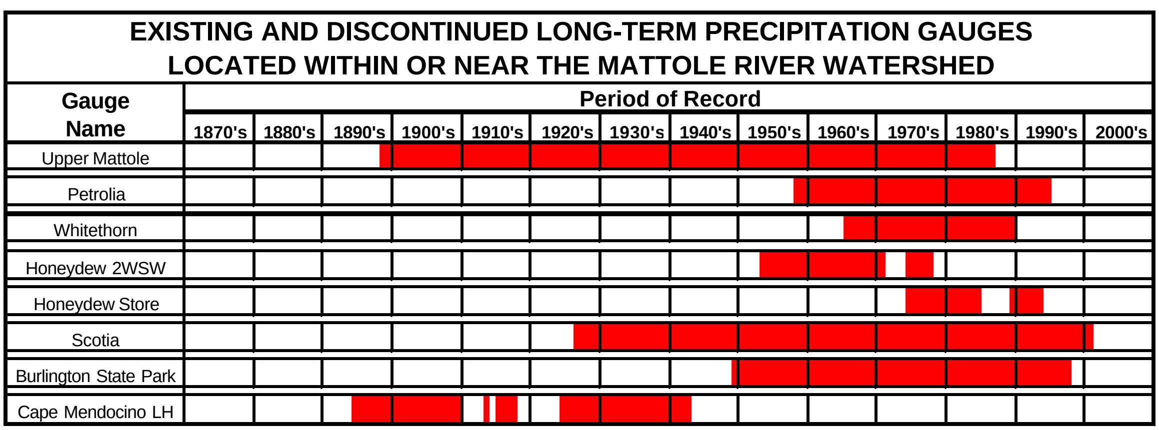


Chart II-2: Annual precipitation and cumulative departure from the mean for the Petrolia rain gauge for the period 1959 - 1995.

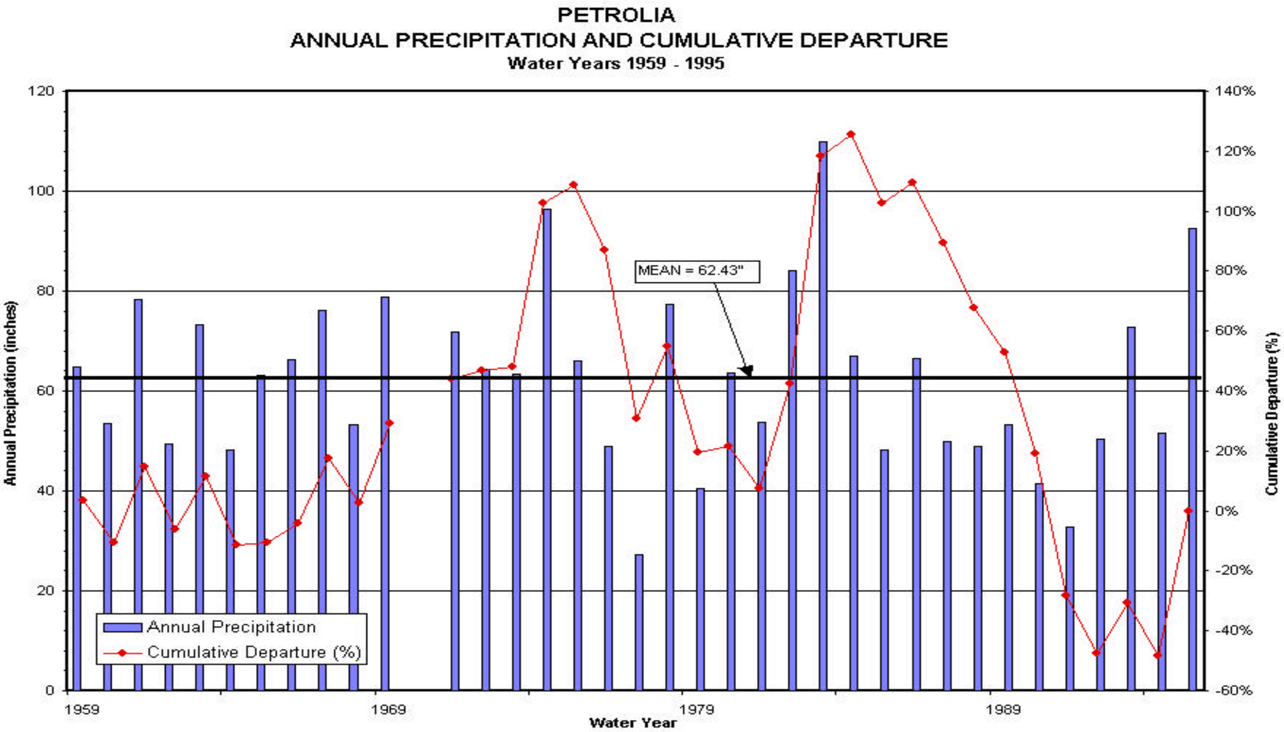


Chart II-3: Annual precipitation and cumulative departure from the mean for the Upper Mattole rain gauge for the period 1898 - 1986.

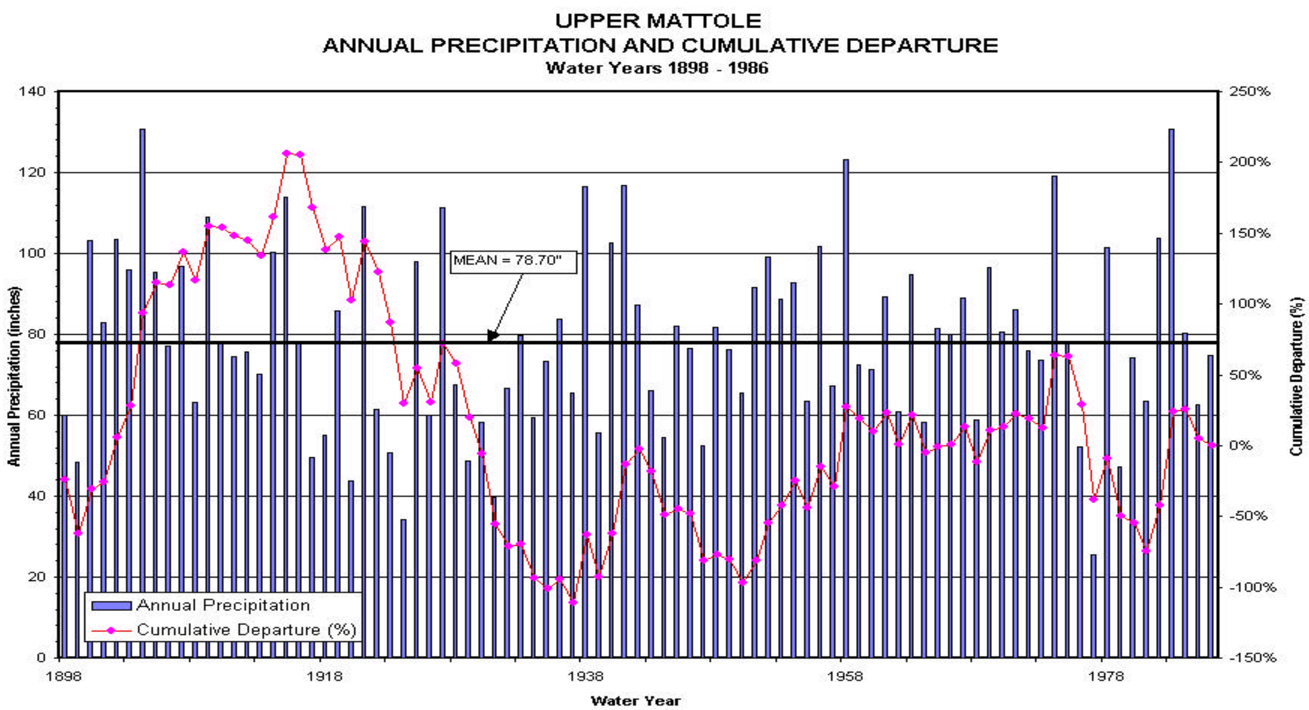
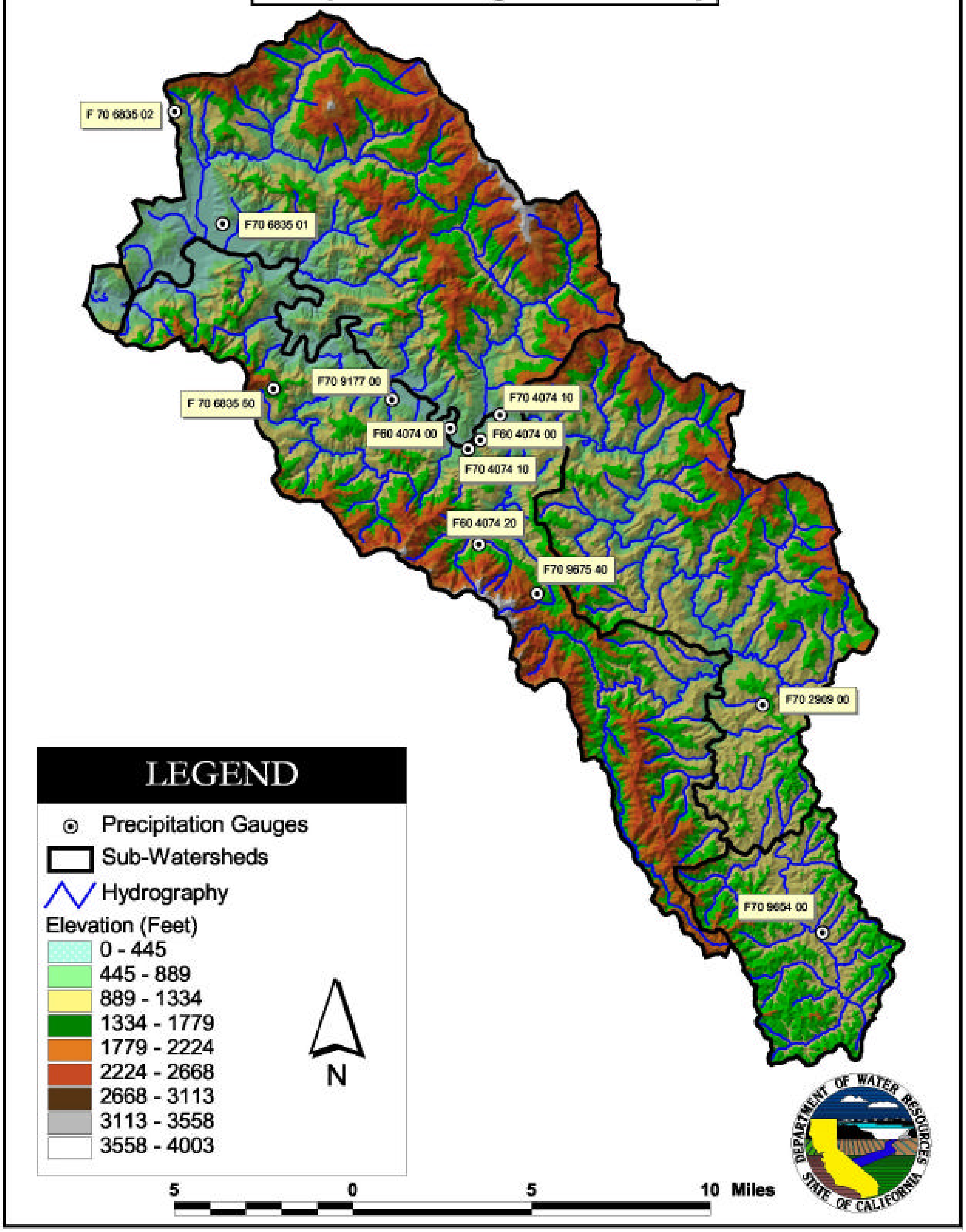


Figure II-1
Mattole River
Precipitation Gauge Location Map



III. STREAM FLOW

Stream flow data are an important component in determining the existing conditions and assisting assessment, restoration, and management activities in North Coast watersheds. Stream flow can be a limiting factor for anadromous fisheries affecting migration and the quantity and quality of spawning, rearing, and refugia areas. Stream flow also has a direct affect on other factors such as water temperature, dissolved oxygen, and sediment and chemical transport. Stream flow data are required to quantify stream sediment and chemical transport total loads and for calibrating hydrologic or hydraulic computer models. Although floodplain management and instream structural design and installation projects are not included in NCWAP, stream flow data is a significant benefit to these as well as other activities including State Water Resources Control Board water right application and license reviews and judicial water supply allocations.

A common complaint of watershed managers is the lack of data and the inability to compare current flow conditions to historic conditions. If long-term data collection programs are not established and supported, water resource managers are forced to sometimes make profound policy, management, and operational decisions based on limited scientific data.

Due to the general lack of stream flow data available within the North Coast region, funding was provided through NCWAP to install and operate stream gauging stations. NCWAP will also provide for the continued operation of selected existing stream gauging stations that are subject to discontinuation due to funding reductions. Additional support for new stream gauging station installation and operation within North Coast watersheds will be provided by the State Water Resources Control Board Surface Water Ambient Monitoring Program (SWAMP). All new stream flow gauging stations will be equipped with water temperature sensors and some with other water quality sensors for measuring parameters such as turbidity, dissolved oxygen, pH, and conductance. Existing stations may also be equipped with additional water quality sensors. Certain selected stations will be equipped with telemetry to provide a portion of the collected data on a real-time basis via the California Data Exchange Center (CDEC) web site. Real-time stream flow and water quality data will assist in notifying this and other data collection efforts of event sampling opportunities or hazardous conditions for fish survival. Flood forecasters and emergency response personnel will also benefit.

Selection of sites, data collection type, and period of station operation will be based on available funding, existing stations, resumption of discontinued stations for historic comparisons, access, favorable site conditions, and special NCWAP or SWAMP identified needs. Stations located at the terminus of the watersheds or major subbasins where none currently exist will be a priority. Some stations will be operated for the long-term for trend and base correlation analysis, while others may only be operated for short periods. Electronic multiple parameter data loggers will be used at all stations to collect highly detailed time series data, normally every 15 minutes or hourly, for all sensors.

DWR and the USGS will work cooperatively to install and operate the new stream gauging stations. Data quality assurance and control techniques developed by the USGS will be employed. The stations will be constructed to withstand substantial flood events and incidental vandalism. Stations installed for short-term operation will be constructed with the assumption that data collection may be resumed at a later date. About 9 to 12 direct stream discharge measurements along with simultaneous water stage (elevation) data over a wide range of water stages will normally be performed annually at each station. High discharge measurements may require the installation of cableway systems if bridges are not located nearby or if measurements by boat are impractical. Multiple direct field measurements of water stage and water quality parameters will also be performed to verify and calibrate the station sensors.

Water stage and water quality time series data will normally be downloaded from the station data loggers and then uploaded into a database and reviewed and edited for accuracy on a monthly basis. Time series stream flow data will be determined by correlating the direct discharge measurements with the simultaneous water stage data. This stage vs. discharge relationship or rating curve is then applied to the stage recordings from the station's stage sensor and data logger to compute stream flow for the same time series interval as water stage, normally every 15 minutes. Once the rating curves are developed, real-time flow data will be provided through the Internet via the CDEC web site for those stations equipped with telemetry. Real-time telemetry also allows the station's operator to monitor the operation of the station remotely allowing a timely response to station malfunctions. Real-time data is normally not reviewed and edited for inaccuracies such as telemetry transmission error, sensor drift or malfunction, or discharge rating curve shift and is considered preliminary and subject to revision. Reviewed finalized data for the October through September water year will normally be available about three to six months after the end of the water year.

Similar to other watersheds within the North Coast, only a few stream flow gauging stations have historically operated within the Mattole watershed. Only one gauge, "Mattole River near Petrolia", was operating at the end of water year 2000 and was scheduled to be discontinued due to budget reductions. Beginning in water year 2001, NCWAP began funding this stream gauge. To gain additional stream flow data, another gauge was installed for NCWAP in June 2001 on the Mattole River near Ettersburg in the upper portion of the watershed. The gauge will measure the discharge from 58 or 19% of the entire 304 square mile Mattole River watershed. The new gauge was also equipped with a temperature sensor. A list of the existing and discontinued stream flow gauging stations along with their location, flow data type, and period of record is shown in Table III-1. Chart Ill-1 graphically illustrates the period of record. A location map is provided in Figure Ill-1.

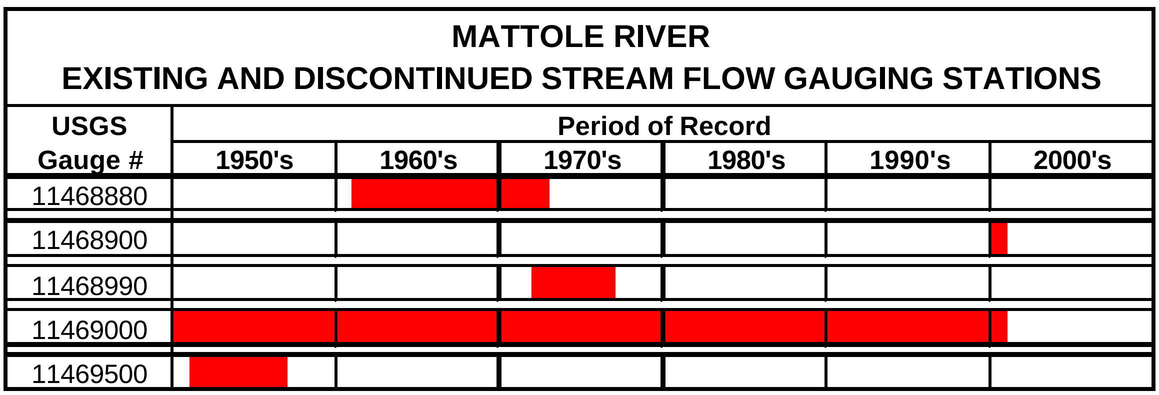
Table III-1: Existing and discontinued stream flow gauging stations within the Mattole River watershed.

MATTOLE RIVER
EXISTING AND DISCONTINUED GAUGING STATIONS

Operating Agency	Station Number	Station Name	1/ Data Type	Drainage Area (sq. mi.)	Elevation (feet)	County	Period of Record
USGS	11468880	Painter Creek near Redway	QP	0.64	950	Humboldt	2/62 - 1/73
USGS	11468900	Mattole River near Ettersburg 2/	QC	58.1	593	Humboldt	7/01 - present
USGS	11468990	Honeydew Creek at Honeydew	QC	14.9	400	Humboldt	1/73 - 9/77
USGS	11469000	Mattole River near Petrolia 3/	QC	245	60	Humboldt	11/11 - 12/13, 12/50 - present
USGS	11469500	N. F. Mattole River at Petrolia	QC	37.6	50	Humboldt	7/51 - 9/57

Notes: 1/ QP = annual peak flow only. QC = continuous flow record.
2/ New station installed and operated for NCWAP.
3/ Station operation funded by NCWAP beginning 10/00.

Chart III-1: Period of record for stream flow gauging stations within the Mattole watershed.



Installation of the new gauge by DWR and the USGS was completed in June 2000. The USGS operated the gauge during water year 2001and have provided preliminary data for stage, discharge, and water temperature. It is usual USGS practice to estimate mean daily data during periods of sensor malfunction. Final edited and reviewed data by the USGS for the entire water year is normally not available until three to six months after the end of the water year. Charts III-2 graphically shows the daily flow for the Petrolia and Ettersburg gauges for water year 2001. Chart III-3 shows the daily average, maximum, and minimum water temperatures for the Ettersburg gauge.

Chart III-2: Daily discharge for the two currently operating stream gauges within the Mattole watershed. Log scale was used to magnify the low flow data.

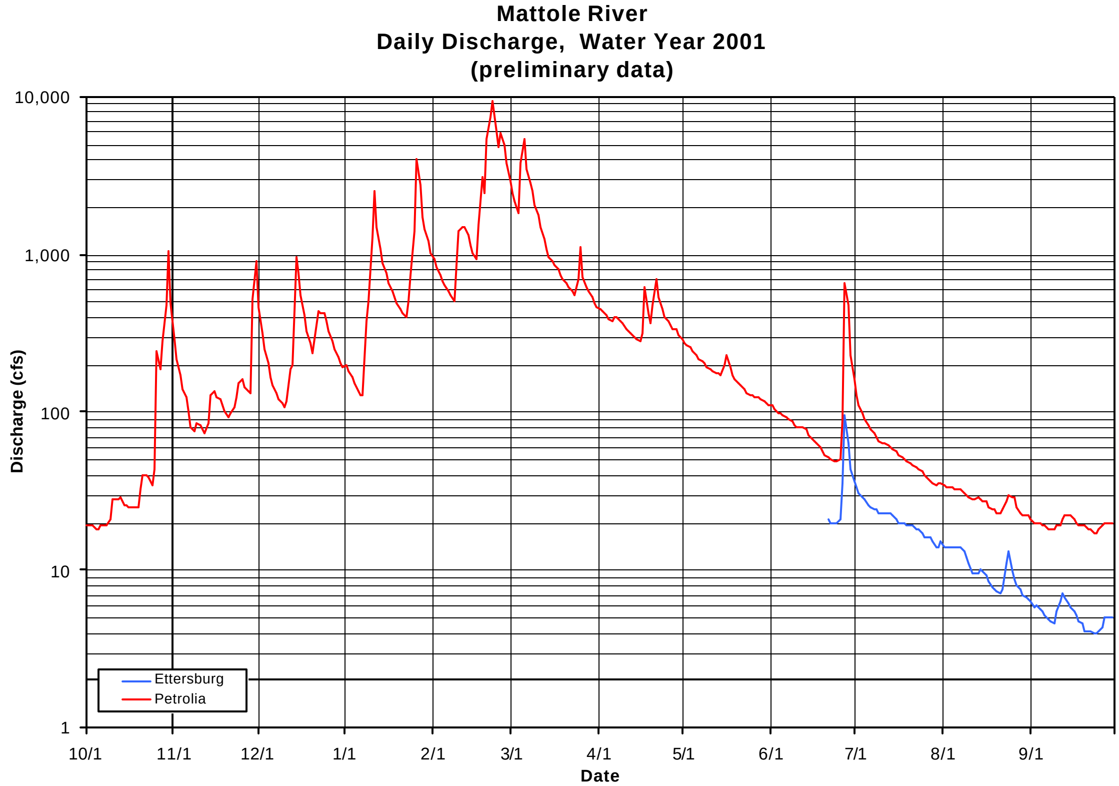
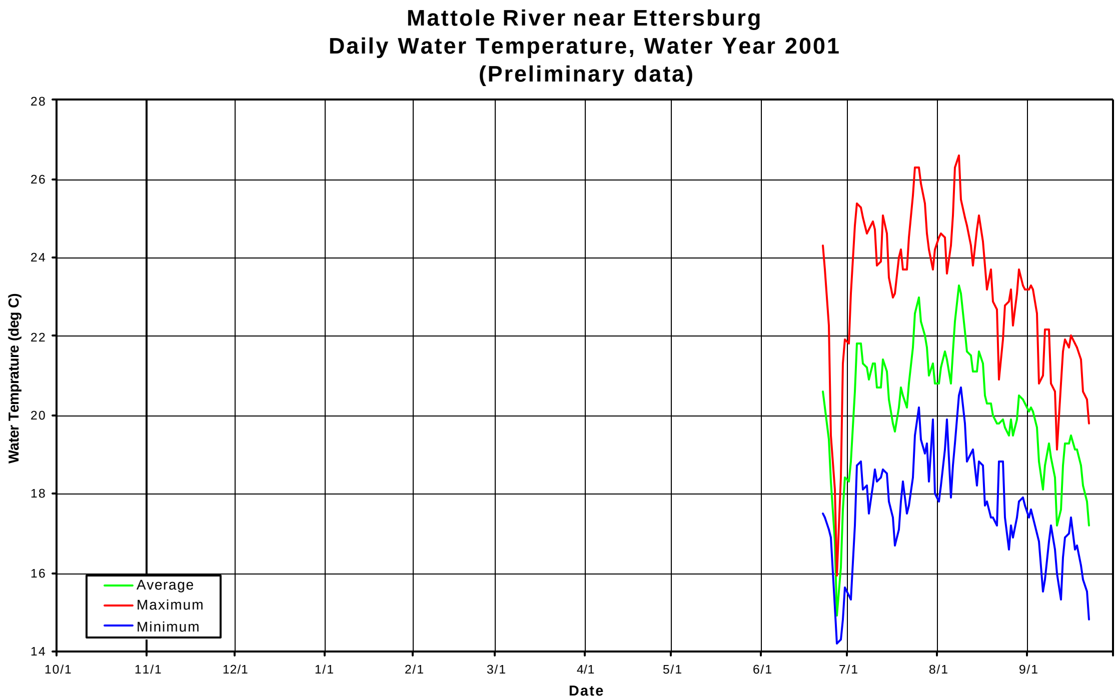


Chart III-3: Daily average, maximum, and minimum water temperature for the new Mattole River near Ettersburg gauge.



Only one stream flow gauge, "Mattole River near Petrolia", USGS gauge #11469000, operated for a significant period (November 1911 – December 1913 and October 1950 – present). This station is located approximately one mile upstream from the town of Petrolia on the main stem of the Mattole River and measures the runoff from 245 or 81% of the total 304 square mile Mattole River watershed. A summary and statistical analysis of the flow data for this station follows.

Table III-2 shows the mean monthly flows for the period of record. Chart III-4 graphically illustrates the mean, maximum, and minimum daily flows for each day of the water year for the period of record. Chart III-5 shows the annual yield or runoff volume in acre-feet for the period of record and the cumulative departure from the mean of the daily mean for the period of record. Chart III-6 presents daily flow duration for the period of record.

A frequency analysis for annual peak and low flow was performed using the techniques from the USGS Bulletin number 17B, Techniques of Water-Resources Investigation of the USGS and Ven Te Chow's Handbook of Hydrology. The data used for the peak flow frequency were the annual instantaneous values. For this analysis, the Gringorten plotting position equation was used as it tended to give better results when using the normal distribution. Table III-3 shows the ranked data, plotting position, and frequencies. Chart III-7 shows the peak discharge for the period of record with the 5-percent moving average superimposed. The moving average describes the general trend of a series. The information from Table III-3 is then utilized to graphically represent peak discharge in the form of return period. See Chart III-8.

The low-flow frequency analysis is similar to the peak-flow analysis except that the discharge values were found by calculating the minimum 7-day running average of the mean daily flows for each water year. These values were then used to complete the frequency analysis described above. Table III-4 shows the ranked data, plotting position, and frequencies. Chart III-9 shows the low flow for the period of record with the 5-year moving average. Chart III-10 represents the low flow return period.

Table III-2: Summary of monthly mean discharge for the period of record for "Mattole River near Petrolia", USGS station #11469000.

Mattole Rever near Petrolia, STA #11469000 Period of Record, (1912-1913, 1950-2000) Mean of Mean Daily Flows (cfs)																
WY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Min	Max	Mean	Total
1912	NR	NR	299	4,496	3,032	2,107	1,012	1,693	436	182	90	179	NR	NR	NR	NR
1913	191	4,022	2,966	5,545	576	675	1,358	417	199	92	41	35	35	5,545	1,343	16,116
1951	1,900	1,900	4,400	4,431	3,915	1,421	308	494	148	67	37	28	28	4,431	1,587	19,048
1952	210	2,392	5,138	5,072	3,834	1,770	487	494	178	96	50	32	32	5,138	1,646	19,752
1953	43	117	3,853	7,200	823	1,900	1,027	1,366	532	166	104	67	43	7,200	1,433	17,196
1954	181	2,490	1,624	7,186	2,869	2,051	2,191	297	150	73	77	80	73	7,186	1,606	19,269
1955	152	1,193	1,991	1,821	591	445	1,975	583	165	83	44	38	38	1,991	757	9,081
1956	39	531	8,340	5,745	3,128	1,429	237	259	112	64	38	32	32	8,340	1,663	19,954
1957	281	240	190	1,246	2,974	3,573	1,073	1,611	357	130	64	136	64	3,573	990	11,875
1958	1,167	1,726	3,251	4,892	10,713	1,860	2,928	289	144	64	39	43	39	10,713	2,260	27,115
1959	44	263	475	5,481	4,514	809	546	176	85	49	30	120	30	5,481	1,049	12,592
1960	56	42	141	1,741	4,556	3,389	1,303	1,842	550	126	64	46	42	4,556	1,155	13,855
1961	78	1,674	3,547	1,507	5,325	3,369	905	1,110	258	98	56	46	46	5,325	1,498	17,975
1962	78	572	1,615	938	4,136	1,990	471	240	109	67	77	67	67	4,136	863	10,358
1963	1,560	1,885	2,588	935	3,951	2,250	5,225	1,263	233	116	60	44	44	5,225	1,676	20,110
1964	625	3,798	831	3,964	872	862	281	161	97	55	36	26	26	3,964	967	11,608
1965	79	1,634	7,745	4,084	883	289	2,258	428	141	68	45	34	34	7,745	1,474	17,687
1966	40	1,583	1,644	4,892	1,940	3,147	725	215	98	52	39	35	35	4,892	1,201	14,408
1967	30	2,695	4,211	4,135	1,599	2,516	2,192	739	211	88	47	40	30	4,211	1,542	18,503
1968	109	243	1,177	3,399	3,099	1,913	407	197	105	59	92	52	52	3,399	904	10,852
1969	152	869	5,368	4,872	3,959	1,544	699	329	156	80	46	40	40	5,368	1,510	18,116
1970	107	416	6,004	8,928	2,042	1,034	286	151	76	39	26	22	22	8,928	1,594	19,130
1971	126	3,481	5,716	4,724	494	3,227	1,332	330	138	76	44	49	44	5,716	1,645	19,736
1972	68	1,752	2,841	3,150	3,467	2,663	1,351	418	177	66	41	65	41	3,467	1,338	16,058
1973	102	1,057	3,856	5,239	2,696	2,013	658	259	106	47	30	123	30	5,239	1,349	16,187
1974	551	7,159	4,428	6,115	1,987	4,350	2,258	277	134	89	43	30	30	7,159	2,285	27,421
1975	33	112	1,197	1,695	8,112	6,877	987	476	172	88	44	35	33	8,112	1,652	19,827
1976	309	956	1,918	782	3,113	1,534	1,267	288	125	59	51	30	30	3,113	869	10,431
1977	30	74	40	135	243	678	167	166	69	31	23	237	23	678	158	1,893
1978	214	1,330	6,330	8,698	4,322	1,925	1,341	411	157	77	59	166	59	8,698	2,086	25,031
1979	51	68	95	1,297	2,812	1,686	895	1,019	197	103	47	52	47	2,812	693	8,322
1980	758	2,179	1,641	3,360	3,290	2,504	1,219	358	157	79	40	28	28	3,360	1,301	15,612
1981	39	125	1,921	3,092	2,414	1,758	658	285	135	63	36	64	36	3,092	882	10,589
1982	416	4,380	6,172	2,160	3,285	2,223	4,529	349	150	75	40	32	32	6,172	1,984	23,811
1983	387	2,488	6,887	3,354	6,460	7,929	2,455	1,177	269	127	164	206	127	7,929	2,659	31,902
1984	123	4,086	6,842	1,004	2,027	1,681	984	535	214	86	50	34	34	6,842	1,472	17,666
1985	106	4,973	1,602	493	1,462	1,043	576	181	101	47	32	31	31	4,973	887	10,646
1986	156	190	1,236	3,356	8,524	3,027	373	427	128	61	34	191	34	8,524	1,475	17,703
1987	204	249	903	2,650	2,729	3,299	388	198	90	47	34	26	26	3,299	901	10,816
1988	24	102	4,782	3,563	515	187	166	239	432	80	39	26	24	4,782	846	10,154
1989	39	2,380	1,433	1,632	856	4,775	1,051	249	115	66	37	28	28	4,775	1,055	12,660
1990	246	116	78	2,094	1,561	964	253	1,219	765	149	69	46	46	2,094	630	7,559
1991	41	62	102	268	710	2,593	533	208	102	51	54	64	41	2,593	399	4,787
1992	53	97	222	867	3,459	1,851	1,052	300	132	84	36	28	28	3,459	682	8,180
1993	100	252	2,659	4,700	2,004	2,449	2,083	989	1,058	191	82	49	49	4,700	1,385	16,615
1994	54	74	2,221	2,233	2,381	948	489	300	130	60	31	25	25	2,381	745	8,945
1995	25	424	1,305	8,709	2,182	5,310	1,676	679	230	102	48	37	25	8,709	1,727	20,726
1996	31	49	3,278	3,709	3,739	2,176	1,761	1,195	356	100	48	46	31	3,739	1,374	16,488
1997	56	968	7,667	4,788	1,254	814	582	293	166	64	41	48	41	7,667	1,395	16,741
1998	110	886	1,899	6,672	7,160	3,477	1,363	455	252	102	47	33	33	7,160	1,871	22,455
1999	49	2,198	2,537	2,059	5,841	3,385	1,553	327	133	57	38	24	24	5,841	1,517	18,201
2000	53	782	922	4,099	5,411	2,179	631	350	129	57	32	24	24	5,411	1,222	14,669
Min	24	42	40	135	243	187	166	151	69	31	23	22				
Max	1,900	7,159	8,340	8,928	10,713	7,929	5,225	1,842	1,058	191	164	237				
Avg	232	1,451	2,926	3,630	3,106	2,308	1,214	548	214	83	51	61				

Chart III-4: Mean, maximum, and minimum daily flow for each day of the water year for the period of record for "Mattole River near Petrolia", USGS station #11469000.

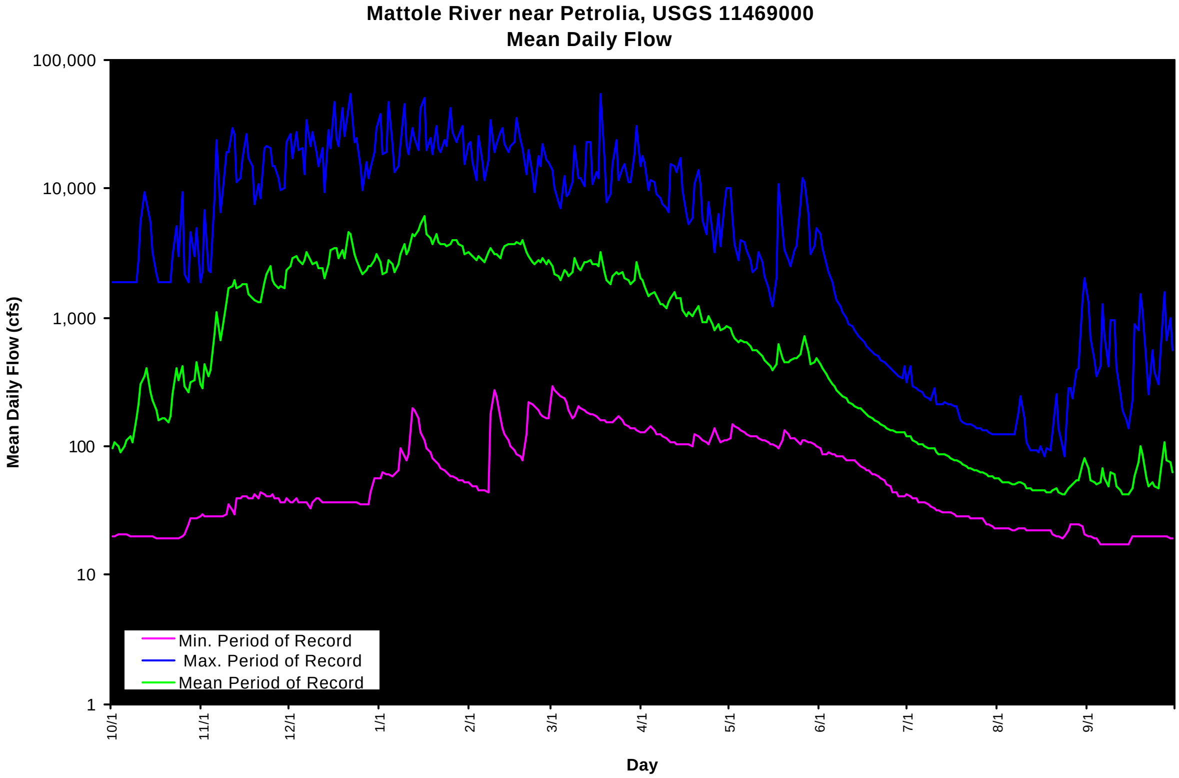


Chart III-5: Annual yield and cumulative departure from the mean for the period of record for "Mattole River near Petrolia", USGS station #11469000.

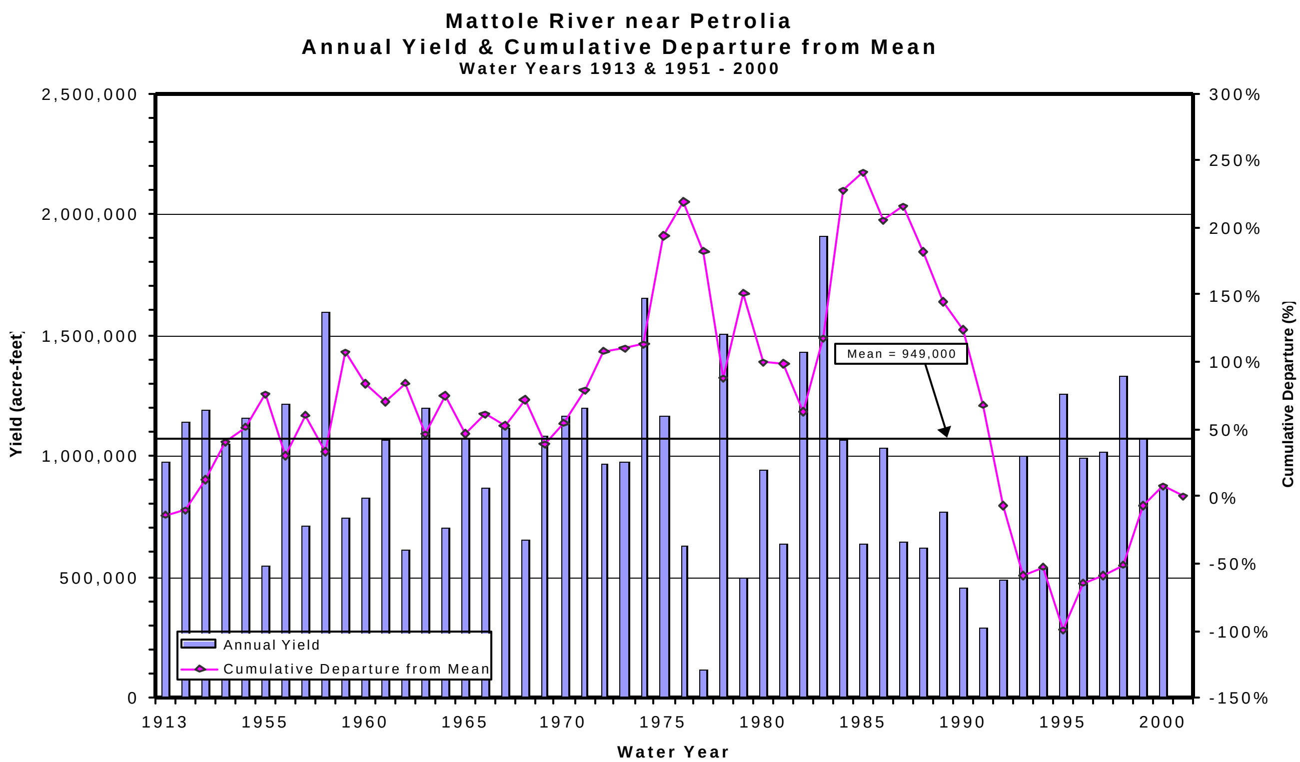


Chart III-6: Daily flow duration for the period of record for "Mattole River near Petrolia" USGS station #11469000.

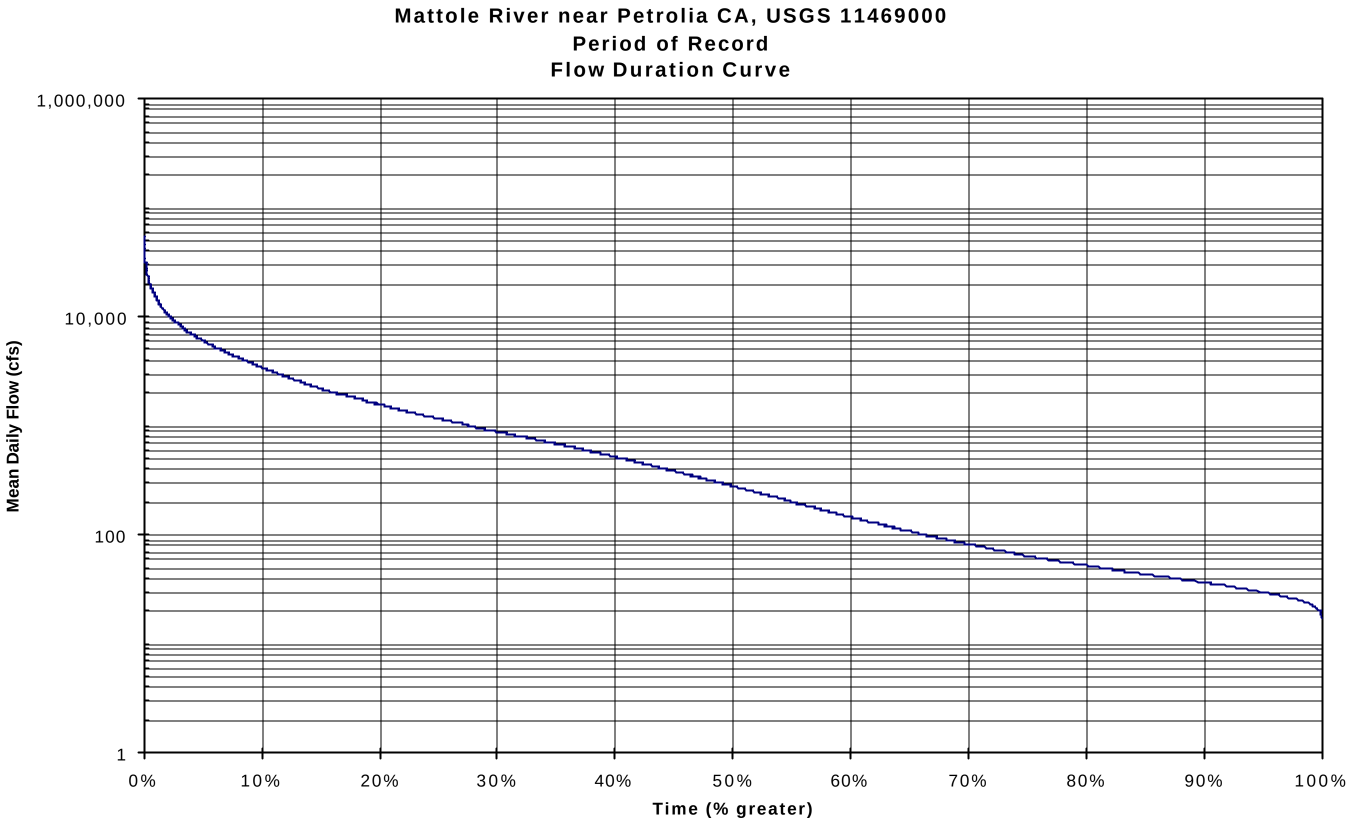


Table III-3: Annual peak instantaneous discharge and frequency analysis for the period of record for "Mattole River near Petrolia", USGS station #11469000.

INSTANTANEOUS PEAK DISCHARGE FREQUENCY ANALYSIS MATTOLE RIVER NEAR PETROLIA, USGS STA# 11469000 PERIOD OF RECORD--WATER YEARS(1912-1913.1951-2000)							
PEAK DISCHARGE			FREQUENCY ANALYSIS			STATISTICS	
Rank	Water Year	Peak Discharge (cfs)	Gringorten Plotting Position	Frequency	Exceedence Probability	Statistical Moments of Discharge	
1	1956	90400	93.07	0.989	0.011		
2	1965	78500	33.41	0.970	0.030		
3	1974	62100	20.36	0.951	0.049	Mean =	37791.54
4	1960	62000	14.64	0.932	0.068		
5	1975	61200	11.43	0.913	0.087	SDEV =	17555.90
6	1995	58700	9.37	0.893	0.107		
7	1983	57100	7.95	0.874	0.126	Variance =	3.08E+08
8	1966	56900	6.89	0.855	0.145		
9	1982	55500	6.09	0.836	0.164	Skew =	0.54
10	1969	53800	5.45	0.817	0.183		
11	1970	52800	4.94	0.797	0.203		
12	1986	48400	4.51	0.778	0.222		
13	1912	48000	4.15	0.759	0.241		
14	1984	47000	3.84	0.740	0.260		
15	1971	46900	3.58	0.721	0.279		
16	1961	46000	3.35	0.701	0.299		
17	1972	46000	3.15	0.682	0.318		
18	1993	45400	2.97	0.663	0.337		
19	1997	45100	2.81	0.644	0.356		
20	1985	44600	2.66	0.625	0.375		
21	1964	43200	2.54	0.606	0.394		
22	1967	42400	2.42	0.586	0.414		
23	1958	41400	2.31	0.567	0.433		
24	1978	41200	2.21	0.548	0.452		
25	1959	37900	2.12	0.529	0.471		
26	1973	34400	2.04	0.510	0.490		
27	1951	34000	1.96	0.490	0.510		
28	1954	34000	1.89	0.471	0.529		
29	1968	33700	1.82	0.452	0.548		
30	1952	33600	1.76	0.433	0.567		
31	1996	32300	1.71	0.414	0.586		
32	1912	30000	1.65	0.394	0.606		
33	1998	29500	1.60	0.375	0.625		
34	1981	28400	1.55	0.356	0.644		
35	1953	28300	1.51	0.337	0.663		
36	1989	28200	1.47	0.318	0.682		
37	1963	28000	1.43	0.299	0.701		
38	2000	27900	1.39	0.279	0.721		
39	1988	27500	1.35	0.260	0.740		
40	1994	27200	1.32	0.241	0.759		
41	1976	23100	1.29	0.222	0.778		
42	1999	22900	1.25	0.203	0.797		
43	1957	22300	1.22	0.183	0.817		
44	1990	19100	1.20	0.164	0.836		
45	1980	18500	1.17	0.145	0.855		
46	1962	17800	1.14	0.126	0.874		
47	1955	16800	1.12	0.107	0.893		
48	1979	16500	1.10	0.087	0.913		
49	1987	15000	1.07	0.068	0.932		
50	1992	11500	1.05	0.049	0.951		
51	1991	8880	1.03	0.030	0.970		
52	1977	3280	1.01	0.011	0.989		

Table III-4: Annual minimum seven-day running low flow and frequency analysis for the period of record for "Mattole River near Petrolia", USGS station #11469000.

LOW FLOW FRIQUENCY ANALYSIS
MATTOLE NEAR PETROLIA, STA#11469000
7 Day Minimum of the Mean of Daily Mean. POR-(1912-1913,1951-2000)

Ranked Data			Friquency Analysis			Statistics
Rank	Water Yr.	Discharge 7-Day Ave., cfs	Gringorten Return Period	Frequency	Exceedence Probability	Statistical Moments of Diacharge
1	1977	17.0	93.07	0.989	0.011	
2	2000	19.0	33.41	0.970	0.030	
3	1913	20.0	20.36	0.951	0.049	Mean = 28.47
4	1971	20.0	14.64	0.932	0.068	
5	1970	20.3	11.43	0.913	0.087	SDEV = 7.34
6	1988	20.9	9.37	0.893	0.107	
7	1995	21.0	7.95	0.874	0.126	Variance = 5.38E+01
8	1986	21.3	6.89	0.855	0.145	
9	1999	21.7	6.09	0.836	0.164	Skew = 1.39
10	1973	21.9	5.45	0.817	0.183	
11	1994	22.3	4.94	0.797	0.203	
12	1965	23.0	4.51	0.778	0.222	
13	1981	23.0	4.15	0.759	0.241	
14	1987	23.1	3.84	0.740	0.260	
15	1964	23.6	3.58	0.721	0.279	
16	1957	23.9	3.35	0.701	0.299	
17	1989	23.9	3.15	0.682	0.318	
18	1951	24.4	2.97	0.663	0.337	
19	1956	24.9	2.81	0.644	0.356	
20	1975	25.3	2.66	0.625	0.375	
21	1952	25.4	2.54	0.606	0.394	
22	1992	25.4	2.42	0.586	0.414	
23	1985	25.6	2.31	0.567	0.433	
24	1982	26.3	2.21	0.548	0.452	
25	1980	26.6	2.12	0.529	0.471	
26	1972	27.6	2.04	0.510	0.490	
27	1974	27.6	1.96	0.490	0.510	
28	1959	27.7	1.89	0.471	0.529	
29	1967	28.1	1.82	0.452	0.548	
30	1976	28.3	1.76	0.433	0.567	
31	1984	28.4	1.71	0.414	0.586	
32	1996	29.1	1.65	0.394	0.606	
33	1991	29.4	1.60	0.375	0.625	
34	1990	29.9	1.55	0.356	0.644	
35	1955	30.0	1.51	0.337	0.663	
36	1983	30.7	1.47	0.318	0.682	
37	1966	31.9	1.43	0.299	0.701	
38	1998	32.0	1.39	0.279	0.721	
39	1997	33.4	1.35	0.260	0.740	
40	1969	33.7	1.32	0.241	0.759	
41	1993	34.0	1.29	0.222	0.778	
42	1962	34.3	1.25	0.203	0.797	
43	1953	34.4	1.22	0.183	0.817	
44	1958	34.6	1.20	0.164	0.836	
45	1960	36.0	1.17	0.145	0.855	
46	1978	36.4	1.14	0.126	0.874	
47	1968	38.0	1.12	0.107	0.893	
48	1954	38.3	1.10	0.087	0.913	
49	1979	38.3	1.07	0.068	0.932	
50	1961	38.4	1.05	0.049	0.951	
51	1963	42.3	1.03	0.030	0.970	
52	1912	58.0	1.01	0.011	0.989	

Chart III-7: Annual instantaneous peak discharge and 5year moving average. Graph shows the runoff trend for the period of record for "Mattole River near Petrolia", USGS station # 11469000.

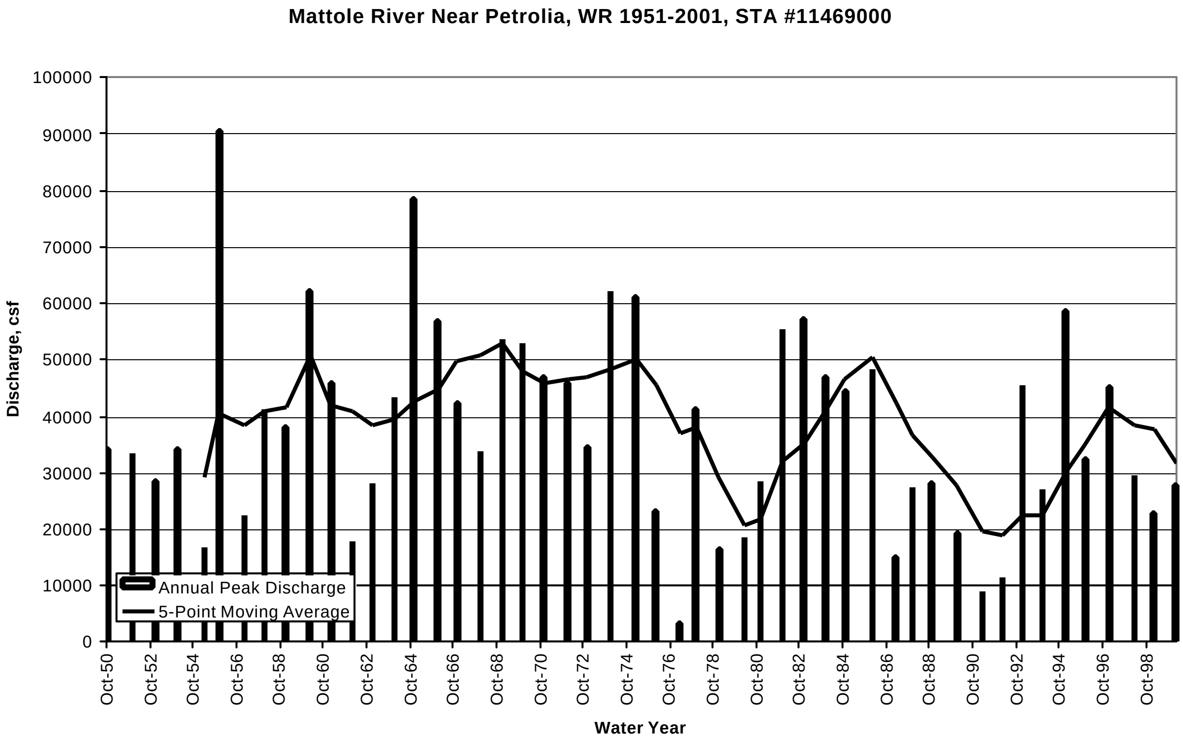


Chart III-8: Annual peak flow return period. Graph shows the theoretical return period in years that a given value will be equaled or exceeded for "Mattole River near Petrolia", USGS station #1146900.

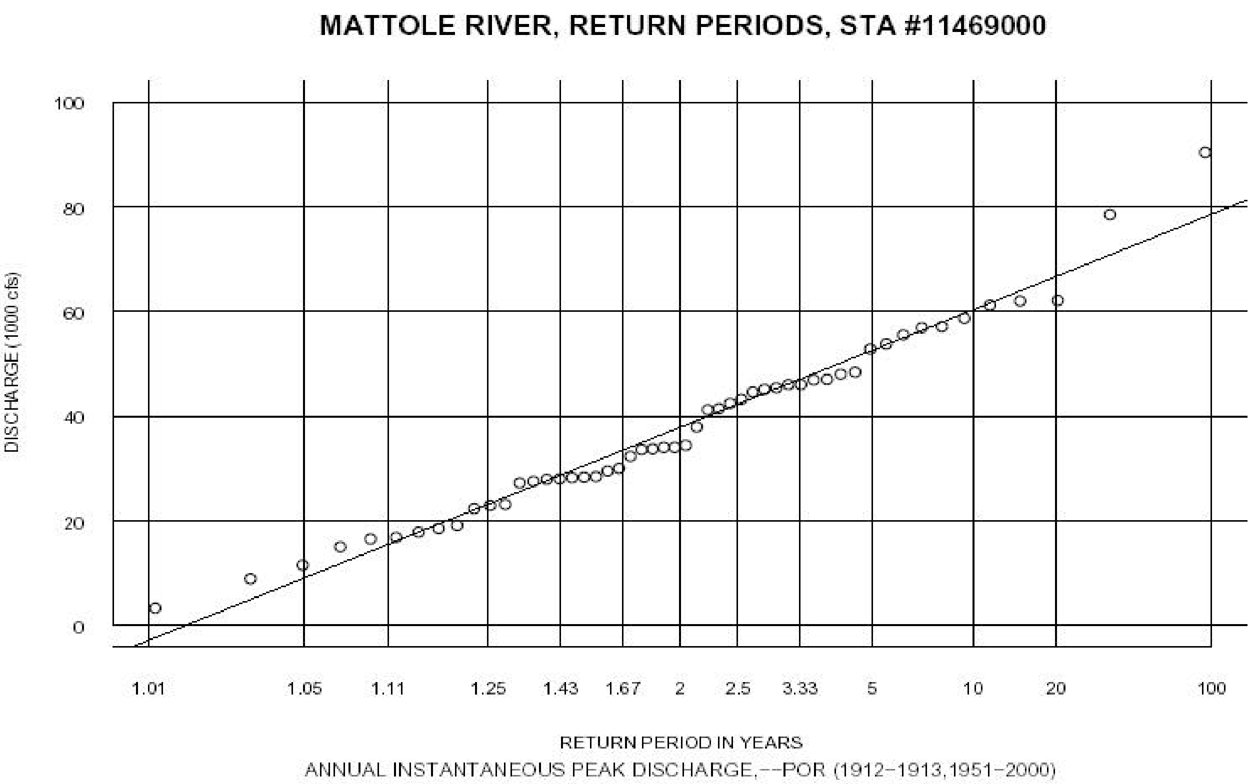


Chart III-9: Annual seven-day running average low flow and the 5year moving average for the period of record for "Mattole River near Petrolia", USGS station #11469000.

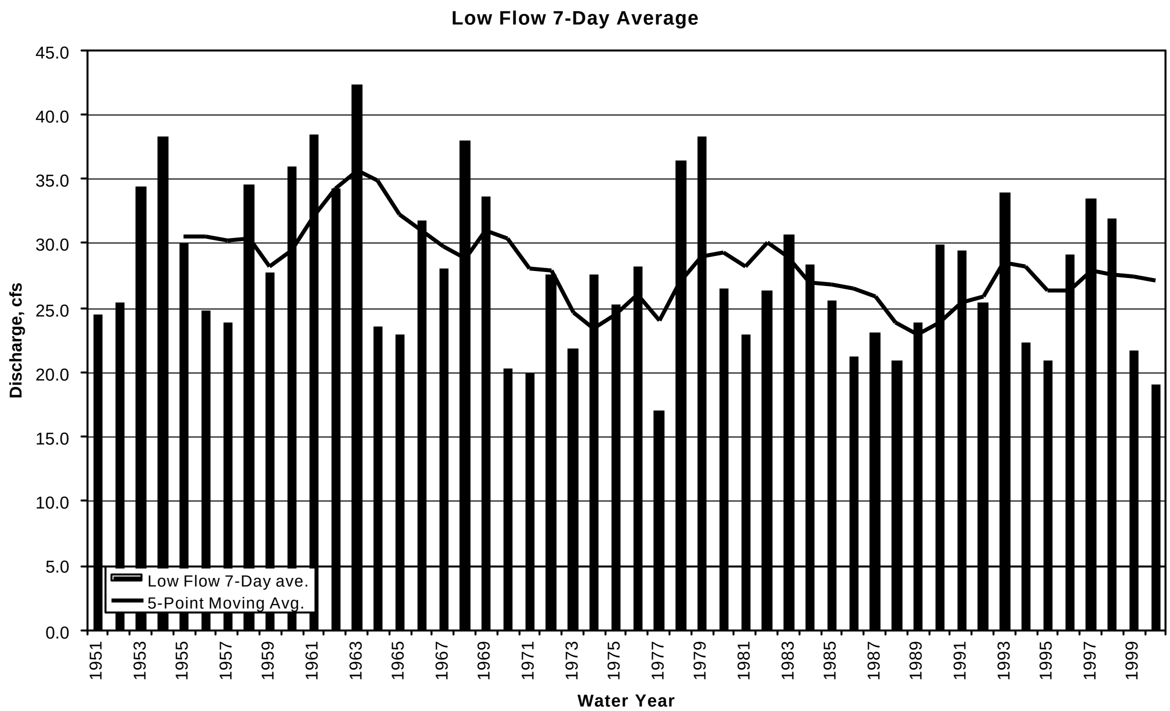
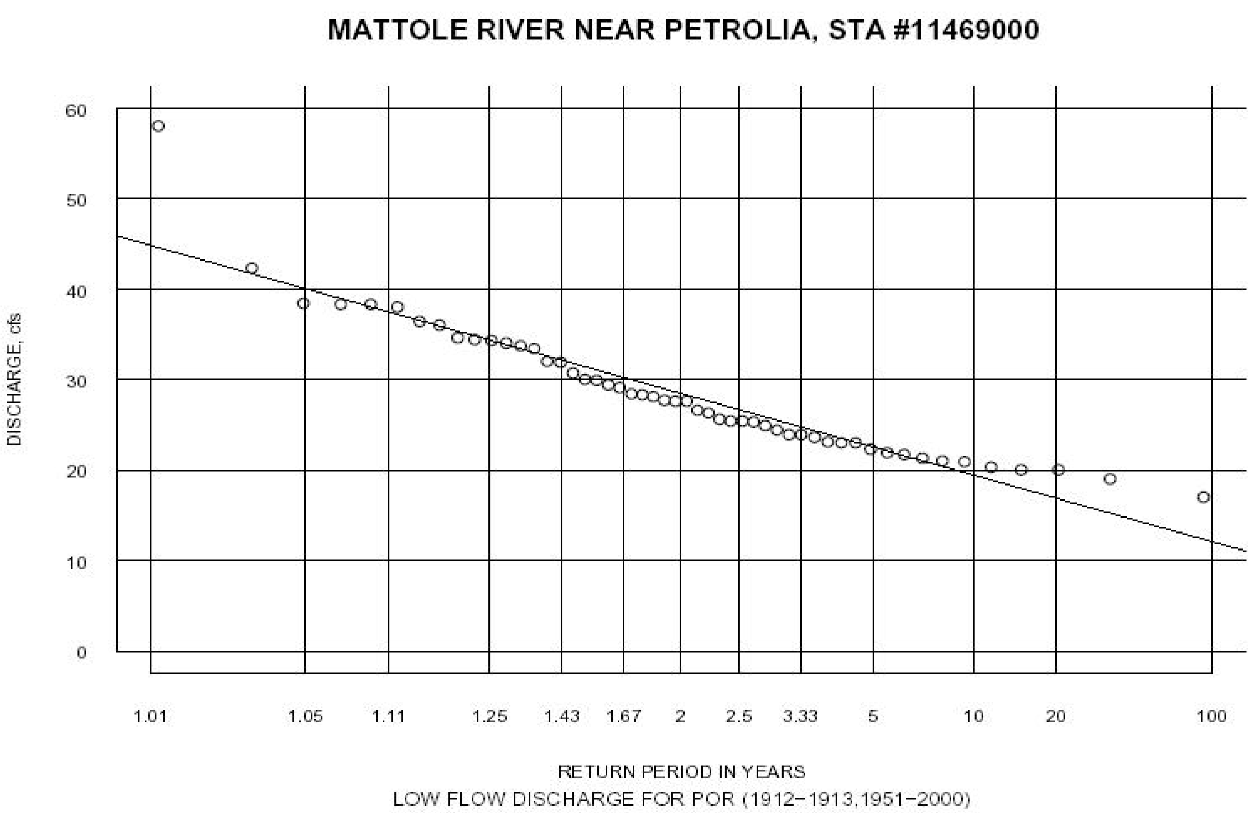


Chart III-10: Annual seven-day running average low flow return period for the period of record for "Mattole River near Petrolia", USGS station #11469000. Graph shows the theoretical return period in years that a given value will be equaled or exceeded.



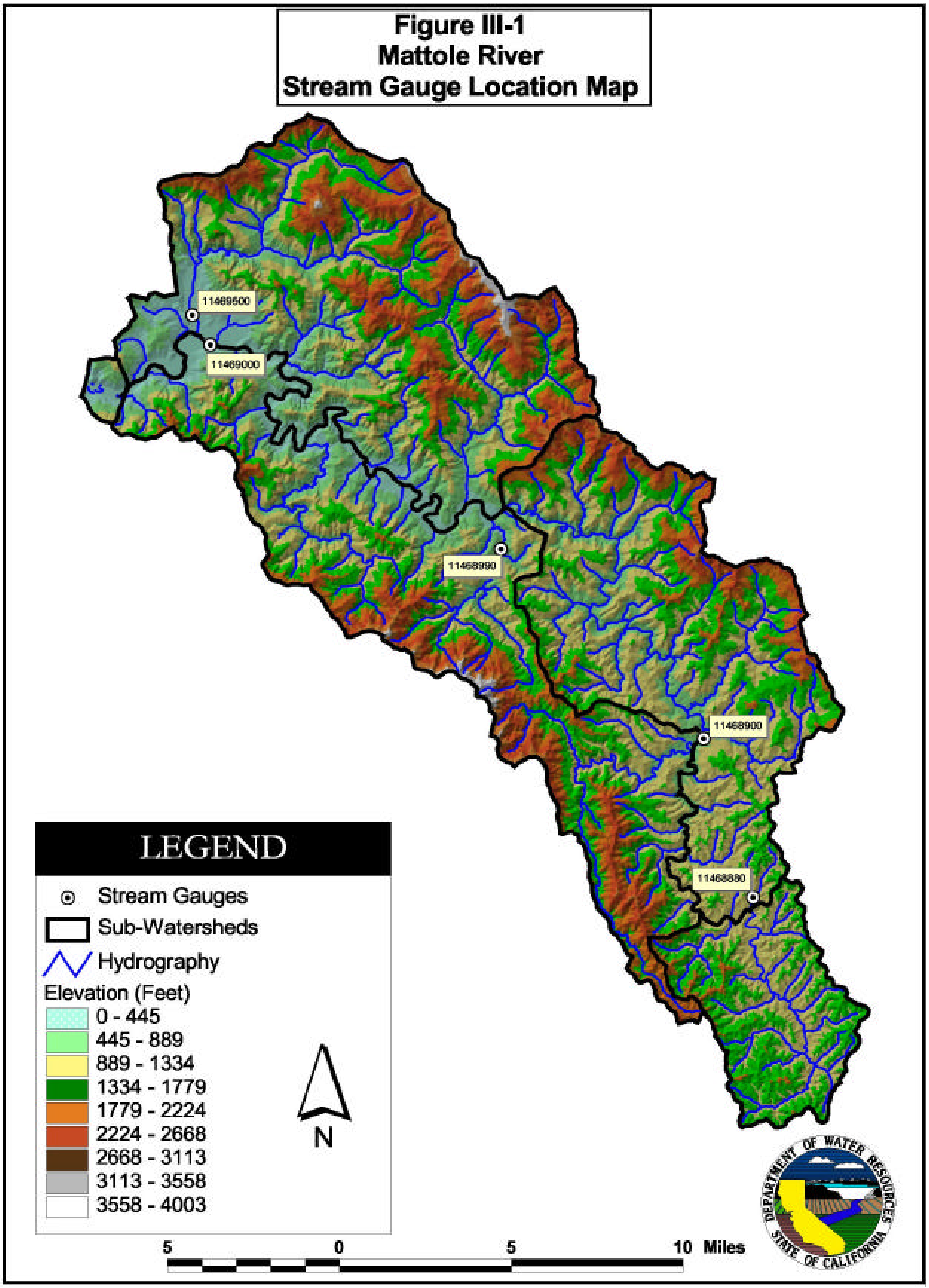


Figure III-1
Mattole River
Stream Gauge Location Map
11469500
11469000
11468990
11468900
11468880
LEGEND
Stream Gauges
Sub-Watersheds
Hydrography
Elevation (Feet)
0 - 445
445 - 889
889 - 1334
1334 - 1779
1779 - 2224
2224 - 2668
2668 - 3113
3113 - 3558
3558 - 4003
N
5
0
5
10 Miles
DEPARTMENT OF WATER RESOURCES
STATE OF CALIFORNIA

IV. SURFACE WATER RIGHTS AND WATER USE

California law recognizes various types of water rights to surface water flow. Their proof of existence and exercise can often be a complicated and controversial issue. Surface water diversions can have a major impact on stream flow and consequently fisheries habitat. Ground water extractions, with a few exceptions, are not subject to California law and can also affect stream flow. A description of the different types of surface water rights can be found at the State Water Resources Control Board (SWRCB) web site (waterrights.ca.gov). A more detailed description is published in an article in the Pacific Law Journal, Volume 19, and Issue 4, entitled "Overview of California Water Law" by William R. Atwater and James Merkle.

The two predominate types of water rights within the Mattole River watershed are riparian and appropriative. The pueblo water right, distinctly recognized by California water law, is very rare and pertains to the right of a city, as the successor of a Spanish or Mexican pueblo (municipality), to the use of water naturally occurring within the old pueblo limits for the use of the inhabitants (Hutchins, 1956). This type of water right has not been established within the Mattole watershed and is not discussed further.

Riparian water rights generally apply to the diversion and use of surface water from a natural watercourse on lands that the watercourse passes through or borders. No California statute defines riparian rights and a State permit is not required, but a riparian water rights doctrine has been established in the State by decisions of the courts and confirmed by Section 3, Article XIV of the California constitution.

Common restrictions and conditions that apply to all riparian water rights include: 1.) the diversion of water is limited to natural flowing water as distinguished from return flows derived from the use of ground water, water seasonally stored and later released, or water diverted from another watershed; 2.) a parcel of land losses its riparian right if it is severed from the land bordering the watercourse unless the right is reserved by deed for the severed parcel: 3.) they are of equal priority with all other riparian rights to the same natural flow of a watercourse regardless of the date of initial use: 4.) they are neither created by use nor lost by nonuse; 5.) they can not be transferred to another parcel of land but can be dedicated to instream flow purposes; 6.) a "Statement of Water Diversion and Use" is required, with certain exceptions, to be filed periodically with the SWRCB. This statement establishes a record of actual water use.

Appropriative water rights generally apply to the diversion and use of water on lands that do not border the watercourse. Appropriative water rights are divided into two types, those initiated before December 1914 (pre-1914) and those initiated after December 1914 (post-1914).

Prior to enactment of the California Water Commission Act in December 1914, the appropriation of water from surface streams was obtained in accordance with the guidelines in Sections 1410 through 1422 of the California Civil Code of 1872. To appropriate water, it was necessary to post a notice at the proposed point of diversion and record a copy of the notice with the respective county recorder. The right was considered valid as long as the appropriator maintained continuous beneficial use of the water. The amount that could be rightfully claimed was fixed by actual beneficial use as to both amount and season of diversion.

In 1914, the California Water Commission Act abolished the procedures previously followed for water appropriation, and established an application process. Water appropriation now requires compliance with the provisions of Division 2, Part 2 of the California Water Code. These provisions established the steps that must be followed to initiate and acquire an appropriative water right. The purpose of filing an application for a permit is to secure a right to the use of unappropriated water and to establish a record of the right so that its status relative to other rights may be determined.

A prospective appropriator must file an application with the SWRCB. The application includes all information pertinent to the development, acquisition, and use of the water, including point of diversion, diversion flow rates, time of diversion, quantity of diversion, and place and purpose of use. The application is then reviewed by the SWRCB. The review process includes: 1.) posting or publication of the application. If protests are received, a hearing or investigation is conducted; 2.) availability of unappropriated water; 3.) possible environmental impacts as required by the California Environmental Quality Act; 4.) possible fisheries impacts by the California Department of Fish and Game.

Although ground water extractions do not generally require a SWRCB application, underground water extractions from "subterranean streams flowing through known and definite channels" are under the SWRCB jurisdiction and are subject to the same review as surface water extractions.

If the application is approved, a permit is issued with terms and conditions to develop the diversion facilities. If the terms and conditions are completed and adhered to during a specific time frame, a license is issued limiting the water user to a quantity of water that was demonstrated as beneficially used during the permitting process. The terms and conditions set by the SWRCB normally apply after the license is issued.

Common conditions and restrictions that apply to all pre-1914 and post-1914 appropriative water rights include: 1.) appropriation of water can be from the natural flow of a watercourse, return flows derived from the use of surface or ground water, water seasonally stored and later released, or water diverted from another watershed; 2.) they can be transferred to other lands or for instream flow purposes; 3.) they typically follow the "first in time, first in right" doctrine of priority among other appropriators but are inferior to riparian water rights. There may be times during the diversion season when no unappropriated water is available; 4.) they can be lost after five years of nonuse; 5.) a "Statement of Water Diversion and Use" is required , with certain exceptions, to be filed periodically with the SWRCB. This statement provides a record of actual water use.

Disputes over the exercise of surface water rights occur and can occasionally only be resolved by court litigation. The SWRCB is authorized to pursue civil action if a water user violates the terms of a post-1914 appropriative water right, but does not have the authority to determine the validity of other vested water rights. The County Superior Courts are sometimes compelled to adjudicate water rights as a result of disputes that can not be resolved by other methods. A typical water right adjudication defines numerous aspects of the water rights involved including the quantity of use, priority to other vested water rights, point of diversion, and the purpose, place and season of use. Court adjudicated water rights do not currently exist within the Mattole watershed.

A search of the SWRCB's Water Right Information System (WRIMS) was performed to determine the number and types of water rights within the Mattole watershed. The WRIMS database is under development and may not contain all post-1914 appropriative water right applications that are on file with the SWRCB at this time. Some pre-1914 and riparian water rights are also contained in the WRIMS database for those water rights whose users have filed a "Statement of Water Diversion and Use". A list of water rights and associated information contained within WRIMS for the Mattole watershed is presented in Table IV-1. A location map of the point of diversion is shown in Figure IV-1.

According to Table IV-1, SWRCB appropriative water right permits exist for a total of about 3,200 acre-feet per year (ac-ft/yr) of water from the Mattole River watershed, at a maximum diversion rate of about 4.4 cubic feet per second (cfs).

The California Department of Water Resources (DWR) periodically conducts land and water use surveys for the basin as part of its Statewide Planning Program. Arial photographs at a scale of 1:24000 are used to identify land use types. Crop type and water source are then determined or verified by field inspection. DWR uses this data to estimate agricultural water use during an average water supply year and future water use demands for each detailed analysis unit (DAU) of the State and publishes the information in the Bulletin 160 series. DWR combines the Mattole and Bear River watersheds into one DAU. The latest land use survey was conducted in 1996. Table IV-2 presents DWR irrigated agricultural acres, water source, and water use data for the Mattole River watershed portion of DAU #27 for 1996.

Table IV-2: Irrigated agricultural land, water source, and water use within the Mattole River watershed.

MATTOLE RIVER WATERSHED IRRIGATED AGRICULTURAL LAND AND WATER USE FOR YEAR 1996								
	Water Source (gross acres)			Unit Applied Water (acre-feet per acre)		Water Use (acre-feet per year)		
Crop	Ground	Surface	Total	Ground	Surface	Ground	Surface	Total
Almonds	14	0	14	2.0	na	28	0	28
Pasture - partial 1/	0	513	513	na	1.4	0	718	718
Pasture - full 2/	71	0	71	2.0	na	142	0	142
Truck - misc.	6	0	6	1.3	na	8	0	8
Total	91	513	604	na	na	178	718	896
Notes: 1/	Partially irrigated							
2/	Fully irrigated							

Due to the steep mountainous terrain, surface water diversions for commercial irrigated agricultural purposes are relatively minor today and are expected to remain so in the future. However, water extraction for residential use appears to be growing in the basin. Many of these diversions likely occur at locations along the river and during the time of year where stream flow, and consequently fisheries habitat, is not significantly adversely affected. However, rural subdivisions have been developed within the upper basin where natural river flows are less abundant and small but numerous surface water extractions for small irrigation and domestic purposes can have a major impact on surface flows.

DFG and other fisheries restoration personnel have observed major and near total depletion of the river flow during the late summer and early fall months during dry years along reaches within the Southern sub-basin upstream of the confluence with Mill Creek. This area is considered excellent fisheries habitat and any depletion can significantly affect the flow during low runoff periods downstream to Ettersburg and the confluence with Bear Creek. The Southern sub-basin has many rural subdivisions located along the river and since groundwater supplies are limited, many residences and landowners extract water from the river for small irrigation and domestic purposes. Numerous post-1914 SWRCB issued appropriative water rights are located within the area (see Figure IV-1) and many riparian and pre-1914 water rights are probably being exercised as well.

To determine current potential water use by the permanent population of the Mattole watershed, DFG personnel compiled Year 2000 population census data, then applied unit per capita water use factors from the American Water Works Association and the EPA. Table IV-3 summarizes the results for each sub-basin of the Mattole watershed.

Table IV-3: Population and water use within the Mattole River sub-basins.

MATTOLE RIVER WATERSHED POPULATION AND WATER USE FOR YEAR 2000							
Sub-basin	**Permanent Population**	**Area (sq. mi.)**	**Population Density (capita/sq. mi.)**	**Number of Households**	**Daily Water Use (gallons)**	**Daily Water Use (cfs)**	**Annual Water Use (acre-feet)**
Estuary	24	2	12.0	8.6	2,100	0.003	2.4
Northern	200	98	2.0	71.7	17,500	0.027	19.6
Western	297	89	3.3	106	26,000	0.040	29.1
Eastern	405	79	5.1	145	35,500	0.055	39.7
Southern	206	28	7.4	73.8	18,000	0.028	20.2
Total	1,132	296	na	405.1	99,100	0.153	111.0

Ninety percent of the Northern sub-basin's total population lives within three miles of the communities of Petrolia and Honeydew. The Eastern sub-basin has the most "pockets" of people. This is due to the numerous rural subdivisions in the area. This trait is shared with the Southern sub-basin. The major difference is that the Southern sub-basin populations are concentrated along the Mattole River and its major tributaries. Most of the Western sub-basin population lives near the county roads running along the its edge. These roads lie near the river from the estuary to Honeydew, and then generally follow the ridge-tops until reaching the boundary with the Southern sub-basin.

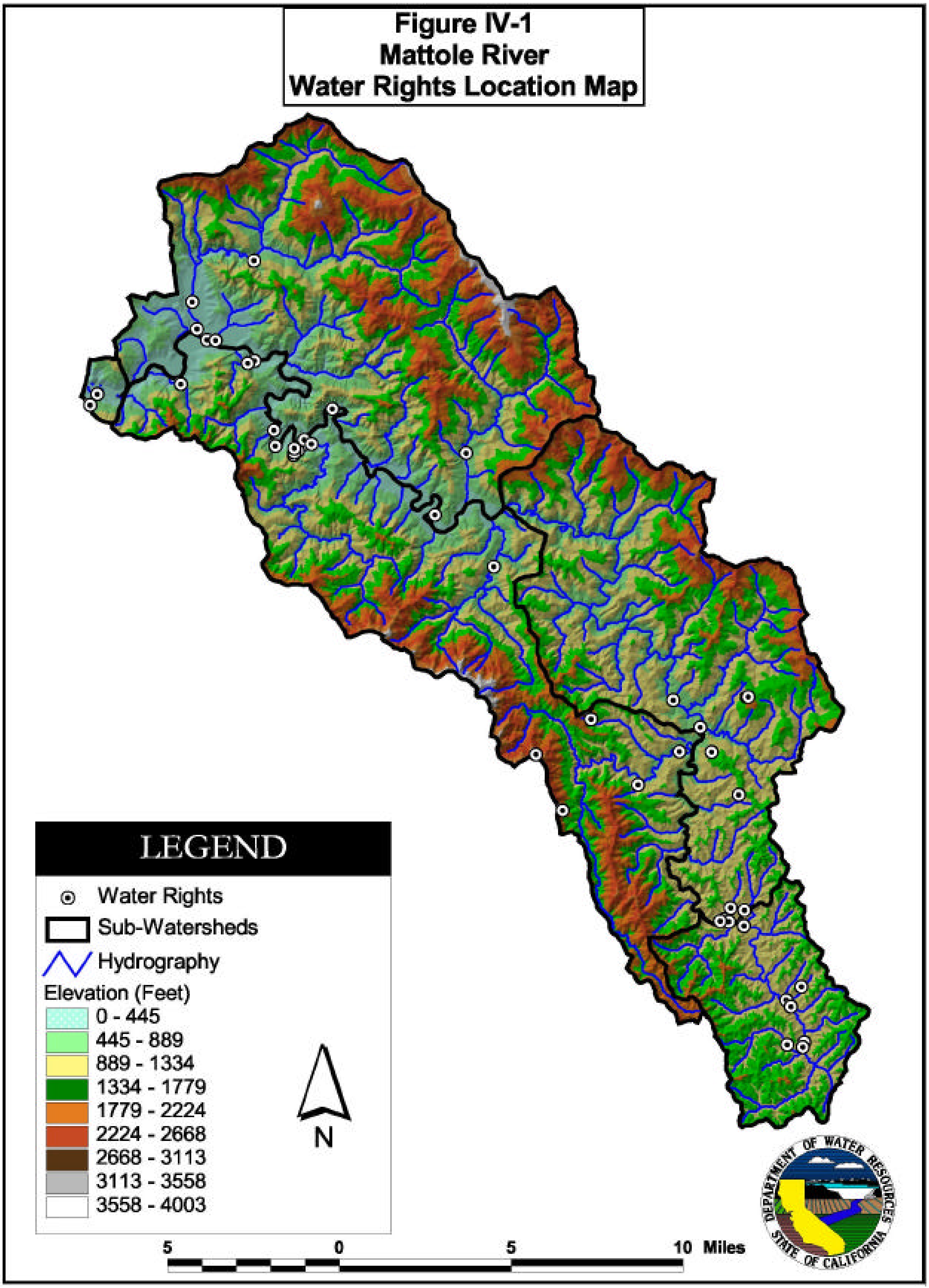


Figure IV-1
Mattole River
Water Rights Location Map
LEGEND
Water Rights
Sub-Watersheds
Hydrography
Elevation (Feet)
0 - 445
445 - 889
889 - 1334
1334 - 1779
1779 - 2224
2224 - 2668
2668 - 3113
3113 - 3558
3558 - 4003
N
5
0
5
10 Miles
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STATE OF CALIFORNIA